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Maruyama et al.

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(54) **COAXIAL CONNECTOR PLUG**

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(51) **Int. Cl.**

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H01R 24/50	(2011.01)
H01R 13/405	(2006.01)

(52) **U.S. Cl.**

CPC ***H01R 24/38*** (2013.01); ***H01R 24/50*** (2013.01); *H01R 13/405* (2013.01)

(58) **Field of Classification Search**

CPC H01R 2201/02; H01R 24/38
USPC 439/63, 578, 916, 944
See application file for complete search history.

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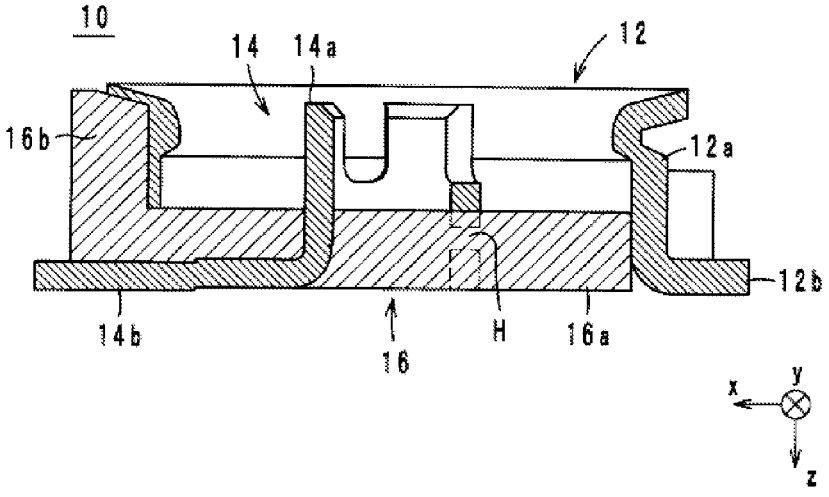
(74) *Attorney, Agent, or Firm* — Studebaker & Brackett PC

(57) **ABSTRACT**

An outer conductor has a substantially cylindrical shape extending in an axial direction. A center conductor has a substantially cylindrical shape extending in the axial direction, and is provided inside the outer conductor. An insulator fixes the center conductor relative to the outer conductor. The center conductor is provided with a hole that communicates with the inside and the outside of the center conductor. The insulator extends, via the hole, to the inside of the center conductor from the outside.

11 Claims, 9 Drawing Sheets



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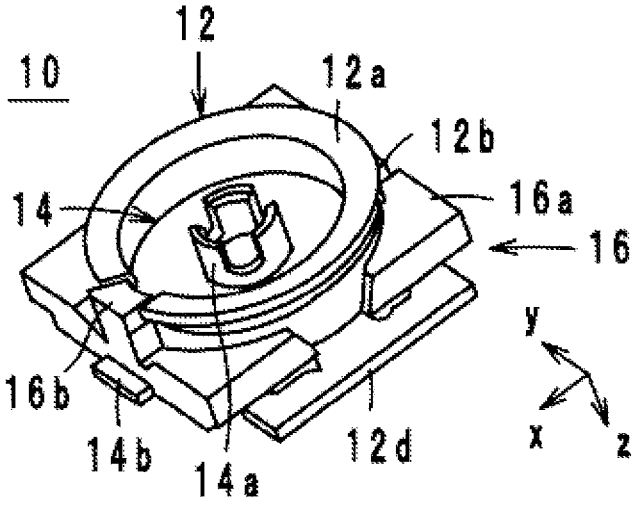
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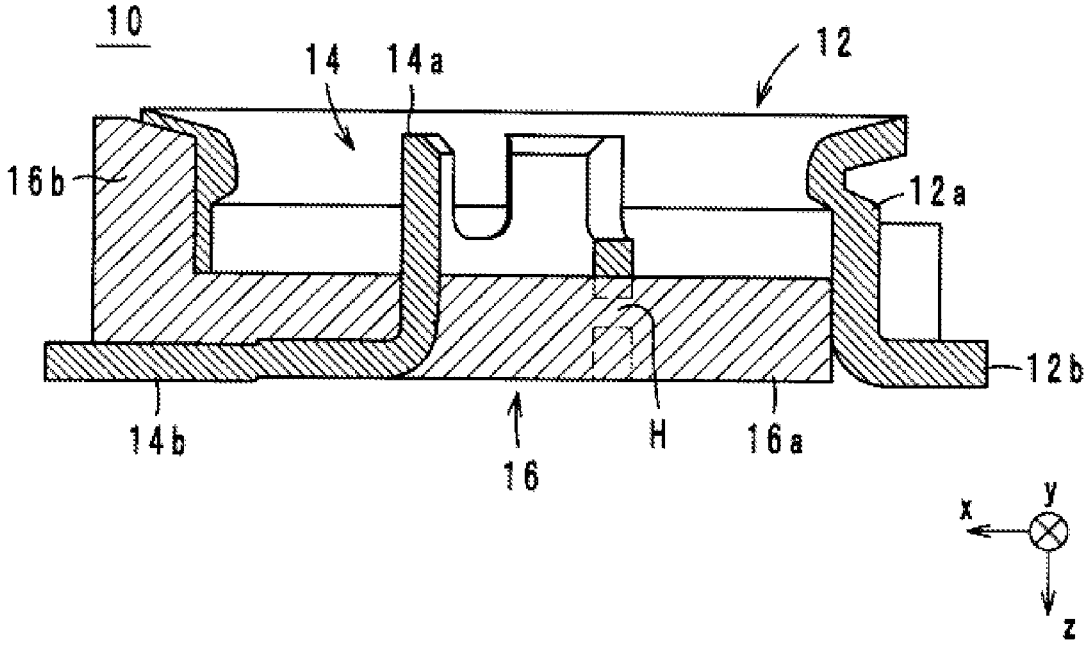
12
12a
12b
14
16a
16
16b
14b
14a
12d
y
x
z

FIG.1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14
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12
16b
12a
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14b
16
H
16a
x
y
z

FIG.2

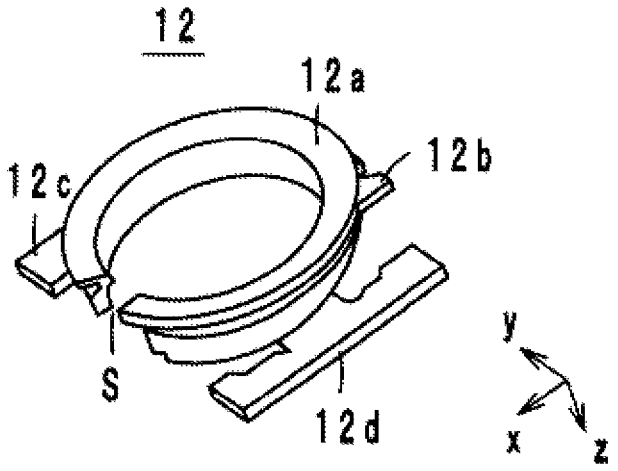


FIG.3

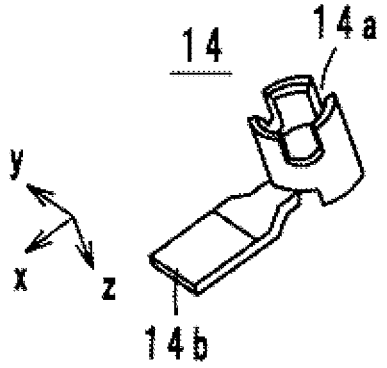


FIG.4

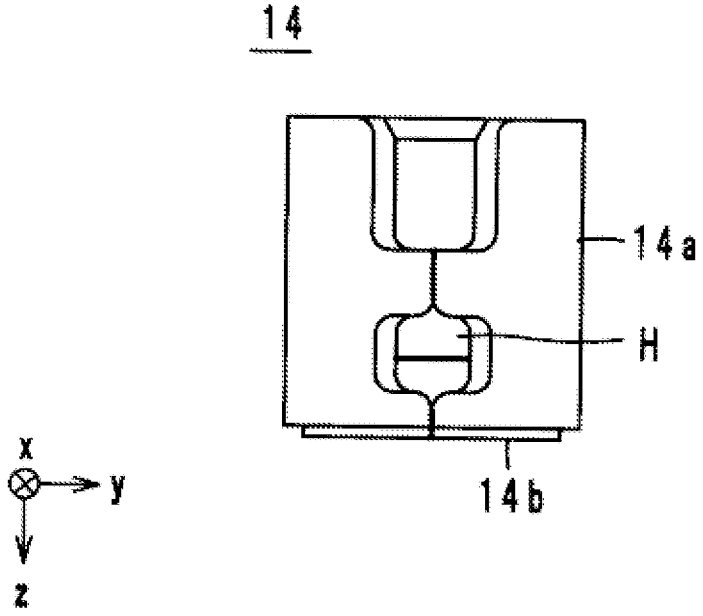


FIG.5

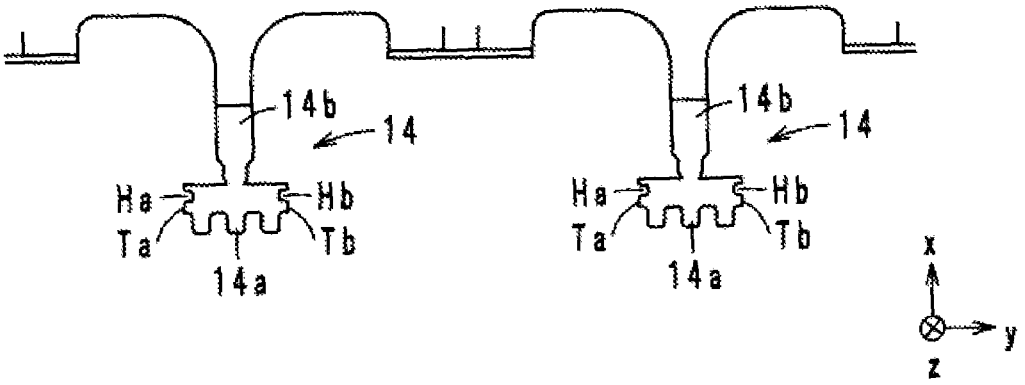

14b
14
Ha
Hb
Ta
Tb
14a
14b
14
Ha
Hb
Ta
Tb
14a
x
y
z

FIG.6A

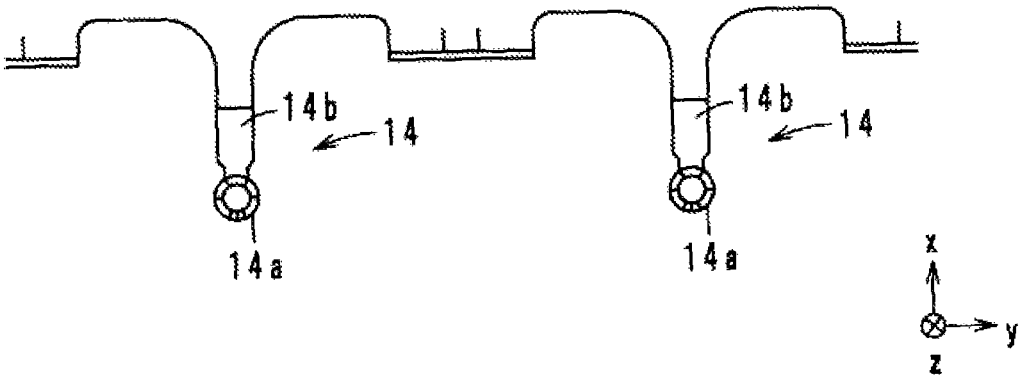

14b
14
14a
14b
14
14a
x
y
z

FIG.6B

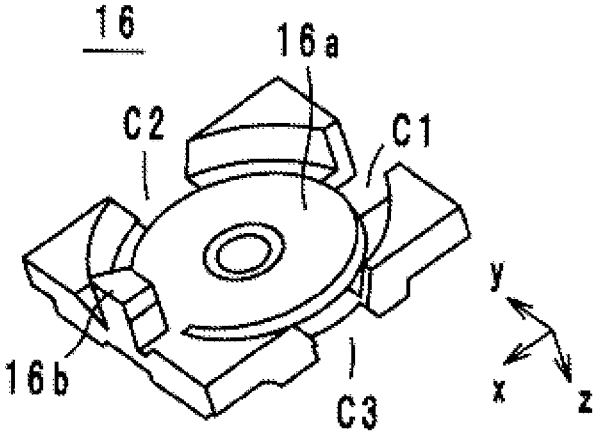


FIG.7

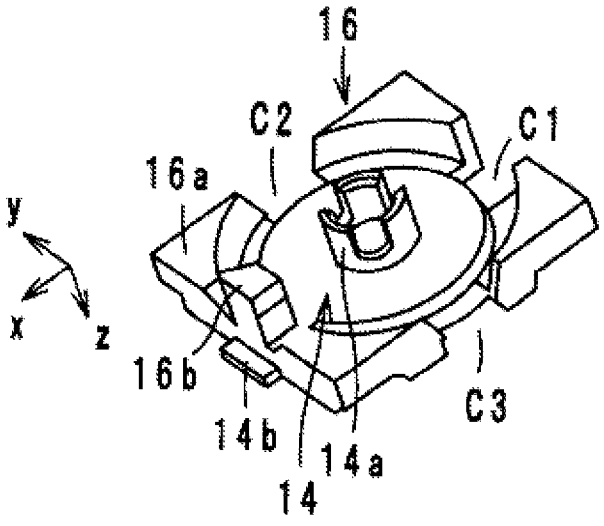
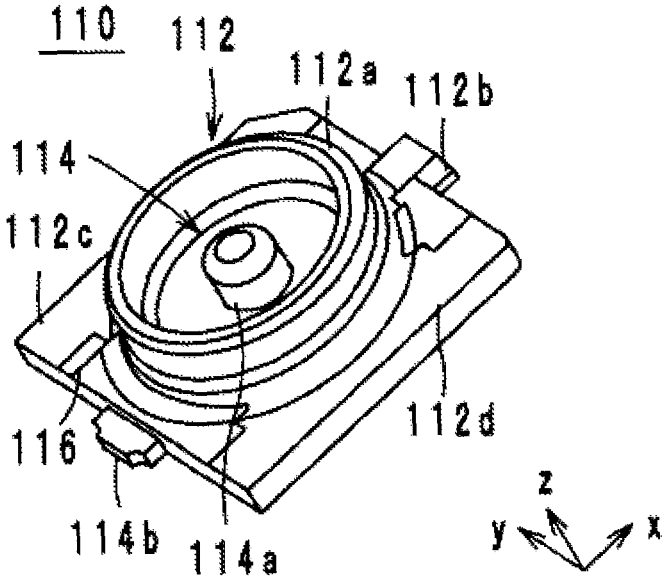


FIG.8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112
112a
112b
114
112c
116
112d
114b
114a
z
y
x

FIG.9

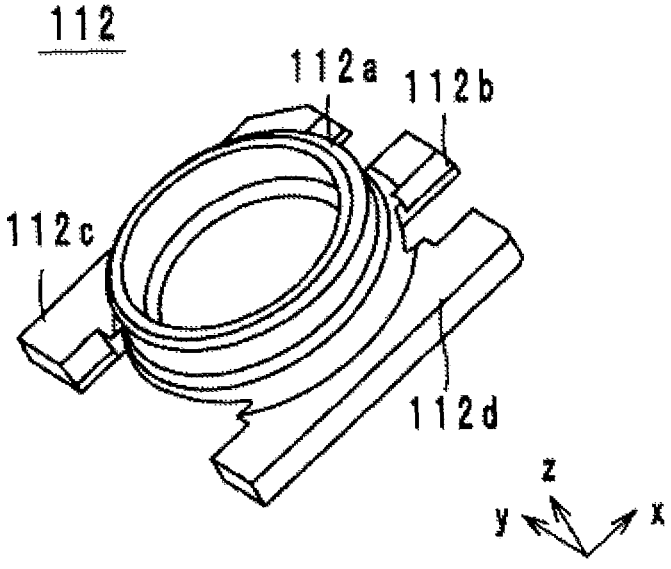
112
112a
112b
112c
112d
z
y
x

FIG.10

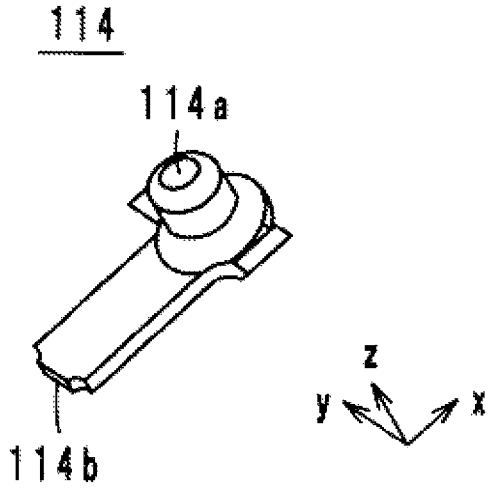

FIG.11

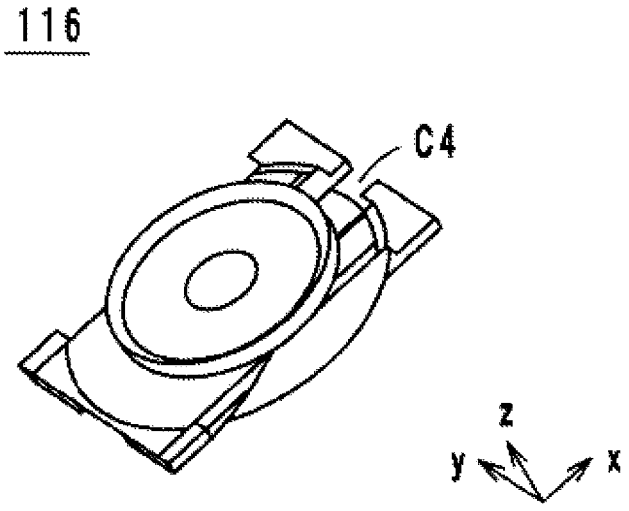

FIG.12

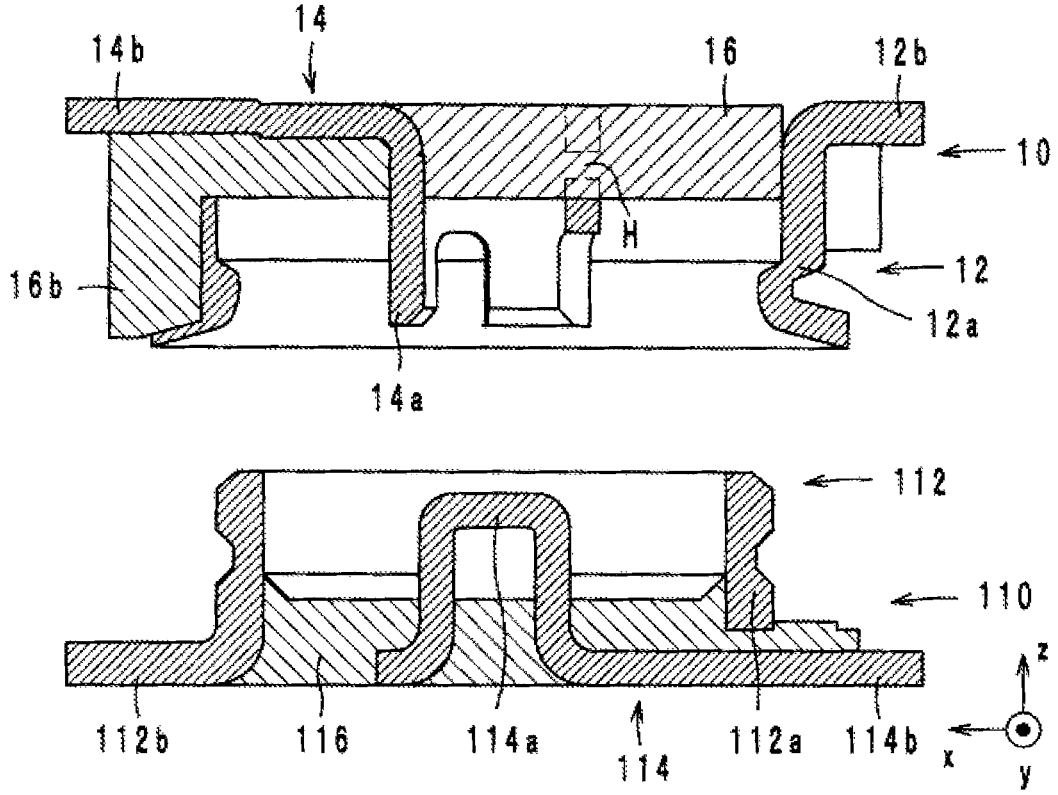

FIG.13A

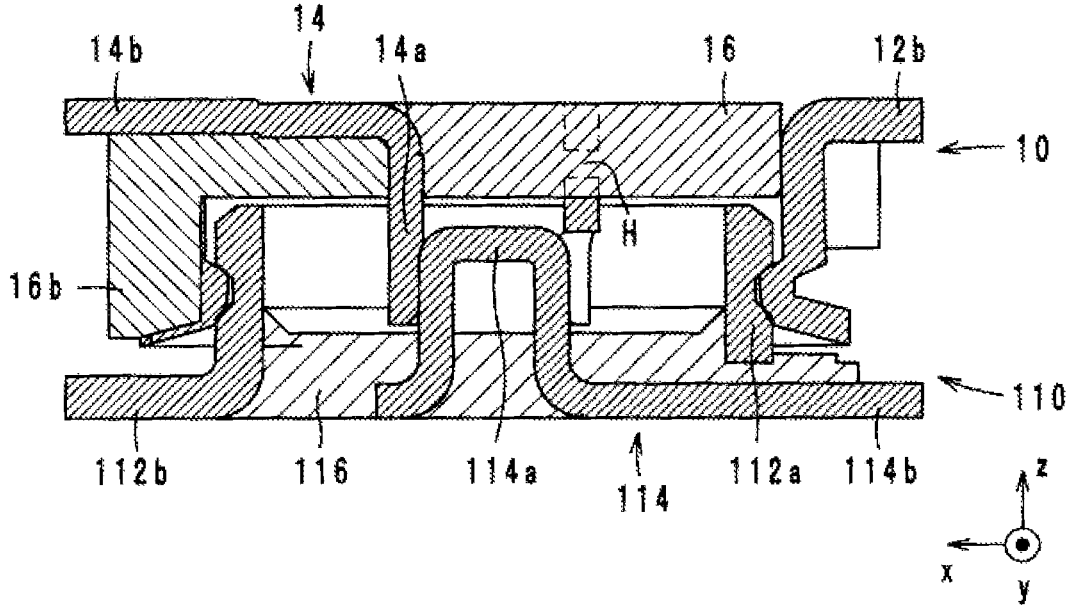

FIG.13B

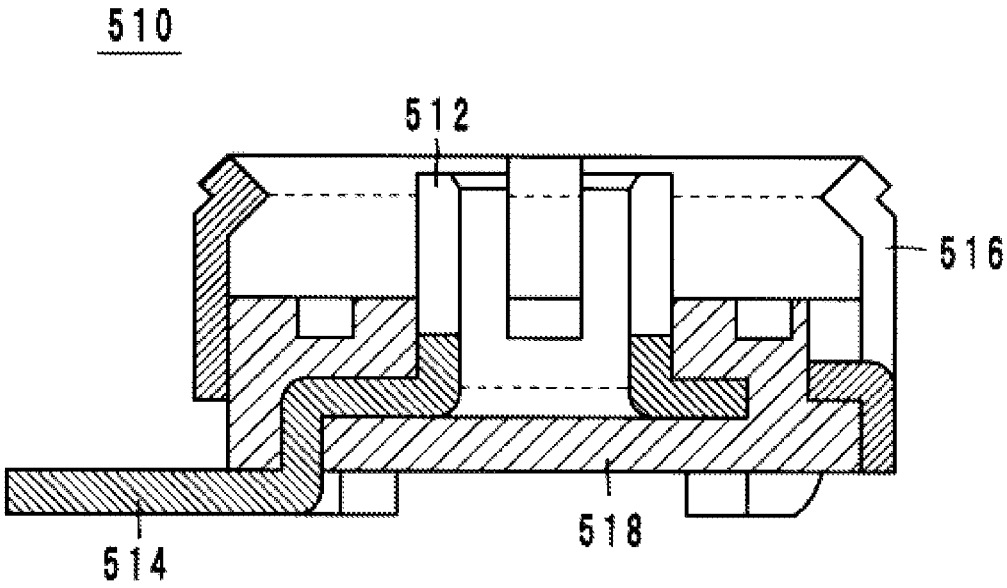

FIG.14
Prior Art

COAXIAL CONNECTOR PLUG

CROSS REFERENCE TO RELATED APPLICATIONS

The present application claims priority to Japanese Patent Application No. 2011-242324 filed on Nov. 4, 2011, the entire contents of this application being incorporated herein by reference in their entirety.

TECHNICAL FIELD

The technical field relates to a coaxial connector plug, and more specifically to a coaxial connector plug including a substantially tubular outer conductor and a substantially tubular center conductor provided inside the outer conductor.

BACKGROUND

A connector plug described in Japanese Unexamined Patent Application Publication No. 2009-104836, for example, is known as a coaxial connector plug according to the related art. FIG. **14** is a cross-sectional view showing the structure of a connector plug **510** described in Japanese Unexamined Patent Application Publication No. 2009-104836.

As shown in FIG. **14**, the connector plug **510** includes a socket-shaped center conductor **512**, a center conductor joint portion **514**, an outside conductor **516**, and an insulating housing **518**. The outside conductor **516** has a substantially cylindrical shape extending in the up-down direction, and is kept at a ground potential. The socket-shaped center conductor **512** is provided at the center of the outside conductor **516**, and has a substantially cylindrical shape extending in the up-down direction. A high-frequency signal is input to and output from the socket-shaped center conductor **512**. The center conductor joint portion **514** is connected to the socket-shaped center conductor **512**, and extends in the horizontal direction. The insulating housing **518** is a resin member that fixes the socket-shaped center conductor **512** at the center of the outside conductor **516**.

It is difficult to lower the profile of the connector plug **510** described in Japanese Unexamined Patent Application Publication No. 2009-104836. Specifically, a receptacle connector is mounted to the connector plug **510**. In this event, a pin-shaped center conductor of the receptacle connector is inserted into the socket-shaped center conductor **512** from the upper side. Therefore, the socket-shaped center conductor **512** is pressed downward. Accordingly, the socket-shaped center conductor **512** may be displaced downward.

Thus, in the connector plug **510**, a portion of connection between the socket-shaped center conductor **512** and the center conductor joint portion **514** is cranked. This allows the insulating housing **518** to be positioned under the socket-shaped center conductor **512**, which suppresses downward displacement of the socket-shaped center conductor **512** because of the presence of the insulating housing **518** even if the socket-shaped center conductor **512** is pressed downward.

SUMMARY

The present disclosure provides a coaxial connector plug that can achieve a reduction in profile while suppressing displacement of a center conductor.

A coaxial connector plug according to an embodiment of the present disclosure includes a first outer conductor formed in a substantially tubular shape extending in an axial direction, a first center conductor formed in a substantially tubular shape extending in the axial direction and provided inside the first outer conductor, and an insulator that fixes the first center conductor relative to the first outer conductor. The first center conductor is provided with a communication portion that communicates with inside and outside of the first center conductor. The insulator extends to the inside of the first center conductor from the outside via the communication portion.

Other features, elements, characteristics and advantages of the present disclosure will become more apparent from the following detailed description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view showing the appearance of a coaxial connector plug according to an exemplary embodiment.

FIG. **2** is a cross-sectional view showing the structure of the coaxial connector plug shown in FIG. **1**.

FIG. **3** is a perspective view showing the appearance of an outer conductive portion of the coaxial connector plug shown in FIG. **1**.

FIG. **4** is a perspective view showing the appearance of a center conductive portion of the coaxial connector plug shown in FIG. **1**.

FIG. **5** is a front view of the center conductive portion of the coaxial connector plug shown in FIG. **1**.

FIGS. **6**A and **6**B show the center conductive portion of the coaxial connector plug in the middle of assembly.

FIG. **7** is a perspective view showing the appearance of an insulator of the coaxial connector plug shown in FIG. **1**.

FIG. **8** is a perspective view showing the appearance of the center conductive portion and the insulator as assembled.

FIG. **9** is a perspective view showing the appearance of a coaxial connector receptacle according to an exemplary embodiment.

FIG. **10** is a perspective view showing the appearance of an outer conductive portion of the coaxial connector receptacle shown in FIG. **9**.

FIG. **11** is a perspective view showing the appearance of a center conductive portion of the coaxial connector receptacle shown in FIG. **9**.

FIG. **12** is a perspective view showing the appearance of an insulator of the coaxial connector receptacle shown in FIG. **9**.

FIG. **13**A is a cross-sectional view showing the structure of an exemplary coaxial connector plug and an exemplary coaxial connector receptacle before being attached to each other.

FIG. **13**B is a cross-sectional view showing the structure of the coaxial connector plug and the coaxial connector receptacle shown in FIG. **13**A after being attached to each other.

FIG. **14** is a cross-sectional view showing the structure of a connector plug described in Japanese Unexamined Patent Application Publication No. 2009-104836.

DETAILED DESCRIPTION

The inventors realized that in a connector plug **510** such as described in Japanese Unexamined Patent Application Publication No. 2009-104836, presence of the insulating housing **518** under the socket-shaped center conductor **512** increases the height of the connector plug **510** by an amount corresponding to the height of the insulating housing **518**. That is, it is difficult to lower the profile of the connector plug **510** described in Japanese Unexamined Patent Application Publication No. 2009-104836.

A coaxial connector plug according to an exemplary embodiment of the present disclosure will now be described with reference to FIGS. **1**-**8**.

FIG. **1** is a perspective view showing the appearance of a coaxial connector plug **10** according to an exemplary embodiment. FIG. **2** is a cross-sectional view showing the structure of the coaxial connector plug **10**. FIG. **3** is a perspective view showing the appearance of an outer conductive portion **12** of the coaxial connector plug **10**. FIG. **4** is a perspective view showing the appearance of a center conductive portion **14** of the coaxial connector plug **10**. FIG. **5** is a front view of the center conductive portion **14** of the coaxial connector plug **10**. FIGS. **6**A and **6**B show the center conductive portion **14** of the coaxial connector plug **10** in the middle of assembly. FIG. **7** is a perspective view showing the appearance of an insulator **16** of the coaxial connector plug **10**. FIG. **8** is a perspective view showing the appearance of the center conductive portion **14** and the insulator **16** as assembled.

In the following description, in FIG. **1**, the direction of the normal to the insulator **16** is defined as a "z-axis direction", and the directions parallel to the two sides of the insulator **16** as viewed from the z-axis direction are defined as an "x-axis direction" and a "y-axis direction". The x-axis direction, the y-axis direction, and the z-axis direction are orthogonal to each other. The z-axis direction is parallel to the direction of the plumb line.

A coaxial connector receptacle to be discussed later is mounted to the coaxial connector plug **10** from the lower side. That is, the coaxial connector plug **10** is used with its opening facing downward. Thus, the lower side of FIG. **1** corresponds to the upper side in the direction of the plumb line, and the upper side of FIG. **1** corresponds to the lower side in the direction of the plumb line. Therefore, the lower side of FIG. **1** is defined as a "positive side" in the z-axis direction, and the upper side of FIG. **1** is defined as a "negative side" in the z-axis direction.

The coaxial connector plug **10** is mounted on a surface of a circuit board such as a flexible printed board, and includes the outer conductive portion **12**, the center conductive portion **14**, and the insulator **16** as shown in FIGS. **1** and **2**.

The outer conductive portion **12** can be fabricated by performing a punching process and a bending process on a single metal plate (made of phosphor bronze, for example) having conductivity and elasticity. Further, the outer conductive portion **12** can be plated with silver or gold. As shown in FIGS. **1** and **3**, the outer conductive portion **12** includes an outer conductor **12***a* and outer terminals **12***b* to **12***d*. As shown in FIGS. **1** to **3**, the outer conductor **12***a* has a substantially cylindrical shape extending in the z-axis direction.

A slit S is formed in the outer conductor **12***a*. The slit S is provided to linearly connect an end portion of the outer conductor **12***a* on the positive side in the z-axis direction and an end portion of the outer conductor **12***a* on the negative side in the z-axis direction. Thus, the outer conductor **12***a* is substantially C-shaped, rather than being continuous to form a substantially annular shape, in plan view from the negative side in the z-axis direction.

The outer terminals **12***b* to **12***d* are connected to the outer conductor **12***a*, and provided on the positive side in the z-axis direction with respect to the outer conductor **12***a*. The outer terminal **12***b* extends from the outer conductor **12***a* toward the positive side in the z-axis direction, and is bent toward the negative side in the x-axis direction. The outer terminal **12***c* extends from the outer conductor **12***a* toward the positive side in the z-axis direction, and is bent toward the positive side in the y-axis direction. The outer terminal **12***c* is substantially T-shaped in plan view from the z-axis direction. The outer terminal **12***d* extends from the outer conductor **12***a* toward the positive side in the z-axis direction, and is bent toward the negative side in the y-axis direction. The outer terminal **12***d* is substantially T-shaped in plan view from the z-axis direction.

The center conductive portion **14** can be fabricated by performing a punching process and a bending process on a single metal plate (made of phosphor bronze, for example). Further, the center conductive portion **14** can be plated with silver or gold. As shown in FIGS. **1** and **4**, the center conductive portion **14** includes a center conductor **14***a* and an outer terminal **14***b*.

As shown in FIG. **1**, the center conductor **14***a* is provided inside the outer conductor **12***a* (more specifically, at the center of the outer conductor **12***a*). That is, the center conductor **14***a* is surrounded by the outer conductor **12***a* in plan view from the z-axis direction. As shown in FIG. **4**, the center conductor **14***a* has a substantially cylindrical shape extending in the z-axis direction. The center conductor **14***a* has three slits extending in the up-down direction. This enables the center conductor **14***a* to be slightly expanded in the horizontal direction.

As shown in FIG. **4**, the outer terminal **14***b* is connected to an end portion of the center conductor **14***a* on the positive side in the z-axis direction, and extends linearly along the positive side in the x-axis direction (in a direction orthogonal to the center axis of the center conductor **14***a*). Note that as shown in FIG. **2**, the outer terminal **14***b* has a small step, for example, of about 0.01 mm. Hence, as shown in FIG. **2**, the outer terminal **14***b* lies beyond a surface of the insulator **16** on the positive side in the z-axis direction by about 0.01 mm. As shown in FIG. **1**, the outer terminal **14***b* is located opposite the outer terminal **12***b* across the center of the outer conductor **12***a* in plan view from the z-axis direction.

As shown in FIG. **5**, a hole (communication portion) H that communicates with the inside and the outside of the center conductor **14***a* is formed in a portion of a side surface of the center conductor **14***a* on the negative side in the x-axis direction. The following describes the hole H along with an exemplary process of manufacturing the center conductive portion **14**.

In fabricating the center conductive portion **14**, as shown in FIG. **6**A, a single metal plate is punched into a substantially T shape. In the state of FIG. **6**A, the center conductor **14***a* is a substantially flat member extending in the y-axis direction. Notches Ha and Hb are formed on respective sides of the center conductor **14***a* at both ends in the y-axis direction. In the state of FIG. **6**A, in addition, the outer terminal **14***b* is a substantially flat member extending from the center of the center conductor **14***a* in the y-axis direction toward the positive side in the x-axis direction. A plurality of center conductive portions **14** are connected to the metal plate at respective end portions of the outer terminals **14***b* on the positive side in the x-axis direction so that the plurality of center conductive portions **14** are arranged in the y-axis direction.

Next, as shown in FIG. **6**B, the substantially flat center conductor **14***a* is curved to be substantially cylindrical. Specifically, the substantially flat center conductor **14***a* is curved into a substantially annular shape such that sides of the center conductor **14***a* at both ends in the y-axis direction are joined to each other. In this event, the notches Ha and Hb are connected to each other, or formed to face each other, to form the hole H. Further, as shown in FIG. **6**B, the cylindrical center conductor **14***a* is bent toward the negative side in the z-axis direction. The center conductive portion **14** is thus completed.

The insulator **16** is a base member fabricated from an insulating material such as a resin, and serves to fix the center conductive portion **14** to the outer conductive portion **12**. As

shown in FIGS. **1** and **7**, the insulator **16** includes a base portion **16***a* and a projection **16***b*. The base portion **16***a* is substantially rectangular in plan view from the z-axis direction, and covers an opening of the outer conductor **12***a* on the positive side in the z-axis direction as shown in FIG. **2**. Note that the base portion **16***a* is provided with notches C**1** to C**3**. The notch C**1** can be formed by removing the center portion of a side of the base portion **16***a* on the negative side in the x-axis direction. The notch C**2** can be formed by removing the center portion of a side of the base portion **16***a* on the positive side in the y-axis direction. The notch C**3** can be formed by removing the center portion of a side of the base portion **16***a* on the negative side in the y-axis direction.

The projection **16***b* is formed by the center portion of a side of the base portion **16***a* on the positive side in the x-axis direction projecting on the negative side in the z-axis direction.

As shown in FIG. **8**, the center conductive portion **14** and the insulator **16** are integrally formed by insert molding. The center conductor **14***a* is thus projected from the center of the base portion **16***a* toward the negative side in the z-axis direction. In addition, as shown in FIG. **2**, the center conductor **14***a* is exposed from a surface of the insulator **16** on the negative side in the z-axis direction. Further, on the positive side in the z-axis direction with respect to the projection **16***b*, the outer terminal **14***b* of the center conductive portion **14** extends from the insulator **16** toward the positive side in the x-axis direction.

Further, as shown in FIG. **2**, the insulator **16** is provided around the center conductor **14***a*, and enters the inside of the center conductor **14***a* from the outside via the hole H. That is, the insulator **16** enters an area surrounded by the inner peripheral surface or wall of the center conductor **14***a* and is also formed on the outer peripheral surface or wall of the center conductor **14***a*. This allows the center conductive portion **14** to be firmly fixed to the insulator **16**.

The outer conductive portion **12** is attached to the insulator **16**. Specifically, the outer terminals **12***b* to **12***d* extend toward the positive side in the z-axis direction with respect to the insulator **16** via the notches C**1** to C**3**, respectively. An opening of the outer conductor **12***a* on the positive side in the z-axis direction is covered by the base portion **16***a* of the insulator **16**. As shown in FIG. **1**, the projection **16***b* is positioned in the slit S. That is, the projection **16***b* functions as a lid member to block the slit S. It should be noted, however, that the projection **16***b* does not contact the outer conductor **12***a*. That is, a slight gap is present between the projection **16***b* and the outer conductor **12***a*. This allows the outer conductor **12***a* to be slightly deformed in the direction of reducing its diameter.

A coaxial connector receptacle to be detachably mounted to the coaxial connector plug **10** according to an exemplary embodiment will now be described with reference to the drawings. FIG. **9** is a perspective view showing the appearance of a coaxial connector receptacle **110** according to an exemplary embodiment of the present invention. FIG. **10** is a perspective view showing the appearance of an outer conductive portion **112** of the coaxial connector receptacle **110**. FIG. **11** is a perspective view showing the appearance of a center conductive portion **114** of the coaxial connector receptacle **110**. FIG. **12** is a perspective view showing the appearance of an insulator **116** of the coaxial connector receptacle **110**.

In the following description, in FIG. **9**, the direction of the normal to the insulator **116** is defined as a "z-axis direction", and the directions parallel to the two sides of the insulator **116** as viewed from the z-axis direction are defined as an "x-axis direction" and a "y-axis direction". The x-axis direction, the y-axis direction, and the z-axis direction are orthogonal to each other. The z-axis direction is parallel to the direction of the plumb line.

The coaxial connector receptacle **110** is mounted to the coaxial connector plug **110** from the lower side. That is, the coaxial connector receptacle **110** is used with its opening facing upward. Thus, the upper side of FIG. **9** corresponds to the upper side in the direction of the plumb line, and the lower side of FIG. **9** corresponds to the lower side in the direction of the plumb line. Therefore, the upper side of FIG. **9** is defined as a "positive side" in the z-axis direction, and the lower side of FIG. **9** is defined as a "negative side" in the z-axis direction.

The coaxial connector receptacle **110** can be mounted on a surface of a circuit board such as a glass epoxy printed board, and includes the outer conductive portion **112**, the center conductive portion **114**, and the insulator **116** as shown in FIG. **9**.

The outer conductive portion **112** can be fabricated by performing a punching process and a bending process on a single metal plate (made of phosphor bronze, for example) having conductivity and elasticity. Further, the outer conductive portion **112** can be plated with silver or gold. As shown in FIGS. **9** and **10**, the outer conductive portion **112** includes an outer conductor **112***a* and outer terminals **112***b* to **112***d*. As shown in FIGS. **9** and **10**, the outer conductor **112***a* has a substantially cylindrical shape extending in the z-axis direction.

The outer terminals **112***b* to **112***d* are connected to the outer conductor **112***a*, and provided on the negative side in the z-axis direction with respect to the outer conductor **112***a*. The outer terminal **112***b* extends from the outer conductor **112***a* toward the negative side in the z-axis direction, and is bent toward the positive side in the x-axis direction. The outer terminal **112***c* extends from the outer conductor **112***a* toward the negative side in the z-axis direction, and is bent toward the positive side in the y-axis direction. The outer terminal **112***c* is substantially T-shaped in plan view from the z-axis direction. The outer terminal **112***d* extends from the outer conductor **112***a* toward the negative side in the z-axis direction, and is bent toward the negative side in the y-axis direction. The outer terminal **112***d* is substantially T-shaped in plan view from the z-axis direction.

The center conductive portion **114** can be fabricated by performing a punching process and a bending process on a single metal plate (made of phosphor bronze, for example). Further, the center conductive portion **114** can be plated with silver or gold. As shown in FIGS. **9** and **11**, the center conductive portion **114** includes a center conductor **114***a* and an outer terminal **114***b*.

As shown in FIG. **9**, the center conductor **114***a* is provided to extend in the z-axis direction at the center of the outer conductor **112***a*. That is, the center conductor **114***a* is surrounded by the outer conductor **112***a* in plan view from the z-axis direction. As shown in FIG. **11**, the center conductor **114***a* has a substantially columnar shape extending in the z-axis direction.

As shown in FIG. **11**, the outer terminal **114***b* is connected to an end portion of the center conductor **114***a* on the negative side in the z-axis direction, and extends toward the negative side in the x-axis direction. As shown in FIG. **9**, the outer terminal **114***b* is located opposite the outer terminal **112***b* across the center of the outer conductor **112***a* in plan view from the z-axis direction.

The insulator **116** is fabricated from an insulating material such as a resin, and is substantially rectangular in plan view from the z-axis direction as shown in FIGS. **9** and **12**. Note that the insulator **116** is provided with a notch C**4**. The notch

C4 can be formed by removing the center portion of a side of the insulator **116** on the positive side in the x-axis direction.

The outer conductive portion **112**, the center conductive portion **114**, and the insulator **116** can be integrally formed by insert molding. The outer conductor **112***a* is thus projected from the center of the insulator **116** toward the positive side in the z-axis direction. Further, an end portion of the outer conductor **112***a* on the negative side in the z-axis direction is covered by the insulator **116**. The outer terminal **112***b* extends to the outside of the insulator **116** via the notch C4. Further, the outer terminals **112***c* and **112***d* extend from a side of the insulator **116** on the positive side in the y-axis direction and a side of the insulator **116** on the negative side in the y-axis direction, respectively, to the outside of the insulator **116**. The center conductor **114***a* projects from the insulator **116** toward the positive side in the z-axis direction in a region surrounded by the outer conductor **112***a*. The outer terminal **114***b* extends from the insulator **116** toward the negative side in the x-axis direction.

Attachment of the coaxial connector receptacle **110** to the coaxial connector plug **10** will now be described with reference to the drawings. FIG. **13**A is a cross-sectional view showing the structure of the coaxial connector plug **10** and the coaxial connector receptacle **110** before being attached to each other. FIG. **13**B is a cross-sectional view showing the structure of the coaxial connector plug **10** and the coaxial connector receptacle **110** after being attached to each other.

As shown in FIG. **13**A, the coaxial connector plug **10** is used with the opening of the outer conductor **12***a* facing the negative side in the z-axis direction. Then, as shown in FIG. **13**B, the coaxial connector receptacle **110** is mounted to the coaxial connector plug **110** from the negative side in the z-axis direction. Specifically, the outer conductor **112***a* is inserted into the outer conductor **12***a* from the negative side in the z-axis direction. The diameter of the outer peripheral surface of the outer conductor **112***a* is designed to be slightly larger than the diameter of the inner peripheral surface of the outer conductor **12***a*. Therefore, the outer peripheral surface of the outer conductor **112***a* is brought into pressure contact with the inner peripheral surface of the outer conductor **12***a*, and the outer conductor **12***a* is pressed to be flexibly expanded in the horizontal direction by the outer conductor **112***a*. That is, the outer conductor **12***a* is expanded such that the width of the entire slit S becomes larger. Then, projections and depressions on the inner peripheral surface of the outer conductor **12***a* and projections and depressions on the outer peripheral surface of the outer conductor **112***a* engage each other. This allows the outer conductor **12***a* to hold the outer conductor **112***a*. The outer conductors **12***a* and **112***a* are kept at a grounding potential during use.

Further, the center conductor **14***a* is physically and electrically connected to the center conductor **114***a*. Specifically, as shown in FIG. **13**B, the center conductor **114***a* is inserted into the substantially cylindrical center conductor **14***a*. The diameter of the outer peripheral surface of the center conductor **114***a* is designed to be slightly larger than the diameter of the inner peripheral surface of the center conductor **14***a*. Therefore, the outer peripheral surface of the center conductor **114***a* is brought into pressure contact with the inner peripheral surface of the center conductor **14***a*, and the center conductor **14***a* is pressed to be expanded so as to be warped in the horizontal direction by the center conductor **114***a*. This allows the center conductor **14***a* to hold the center conductor **114***a*. A signal current flows through the center conductors **14***a* and **114***a* during use.

In embodiments according to the coaxial connector plug **10** configured as described above, it is possible to achieve a reduction in profile while suppressing displacement of the center conductor **14***a*. More specifically, the center conductor **14***a* is provided with the hole H that communicates with the inside and the outside of the center conductor **14***a*, and the insulator **16** enters the inside of the center conductor **14***a* from the outside via the hole H. This allows the center conductor **14***a* to be firmly fixed to the insulator **16**, which suppresses detachment of the center conductor **14***a* from the insulator **16** when the coaxial connector receptacle **110** is mounted. Further, the center conductive portion **14** is fixed by a part of the insulator **16** filling the hole H provided in a side surface of the substantially cylindrical center conductor **14***a*. Thus, the insulator **16** might not be provided on the positive side in the z-axis direction with respect to the center conductor **14***a*. This allows a reduction in profile of the coaxial connector plug **10**.

In the coaxial connector plug **10**, in addition, the center conductor **14***a* is fixed to the insulator **16** by a part of the insulator **16** filling the hole H. This suppresses displacement of the center conductive portion **14***a* when the coaxial connector receptacle **110** is detached from the coaxial connector plug **10**.

A coaxial connector plug according to the present disclosure is not limited to the coaxial connector plug **10** according to the exemplary embodiment described above, and may be changed without departing from the scope of the present disclosure.

In the coaxial connector plug **10**, the hole H is formed in the center conductor **14***a* to allow entry of the insulator **16** to the inside of the center conductor **14***a*. However, the insulator **16** may enter the center conductor **14***a* via a communication portion other than the hole H that communicates with the inside and the outside of the center conductor **14***a*. For example, a notch may be provided at an end portion of the center conductor **14***a* on the positive side in the z-axis direction, and the insulator **16** may enter the center conductor **14***a* via the notch.

The hole H is formed by connecting the notches Ha and Hb to each other as shown in FIG. **6**A. However, the hole H may be formed by providing at least one of the notches Ha and Hb.

As has been described above, embodiments consistent with the present disclosure are useful for coaxial connector plugs, and excellent in particular in achieving a reduction in profile while suppressing displacement of a center conductor.

While exemplary embodiments of the invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the disclosure.

What is claimed is:

1. A coaxial connector plug comprising:

a first outer conductor formed in a substantially tubular shape extending in an axial direction;

a first center conductor formed in a substantially annular shape extending in the axial direction that has slits which enable the first conductor to be expanded in a direction perpendicular to the axial direction and provided inside the first outer conductor; and

an insulator that fixes the first center conductor relative to the first outer conductor, wherein

the first center conductor is provided with a communication portion that communicates with inside and outside of the first center conductor, and

the insulator extends to the inside of the first center conductor from outside the first center conductor via the communication portion and does not extend to a bottom surface of the first center conductor,

the communication portion is a hole provided in the first center conductor,

the first center conductor has a substantially plate-shaped member being curved to be the substantially annular shape such that both ends of the substantially plate-shaped member are joined to each other, and

the hole is formed by providing a notch in at least one of the both ends of the substantially plate-shaped member.

2. The coaxial connector plug according to claim **1**,

wherein the first center conductor is substantially cylindrical.

3. The coaxial connector plug according to claim **1**,

wherein the insulator covers an opening of the first outer conductor, and

an end of the first center conductor is exposed from a surface of the insulator.

4. The coaxial connector plug according to claim **1**,

wherein the insulator is fabricated from a resin.

5. The coaxial connector plug according to claim **1**, further comprising:

an outer terminal connected to the first center conductor and extending linearly along a direction orthogonal to the axial direction.

6. The coaxial connector plug according to claim **1**,

wherein the first outer conductor is configured to insert a second outer conductor in a substantially tubular shape of a coaxial connector receptacle, and

the first center conductor is configured to insert a second center conductor of the coaxial connector receptacle.

7. The coaxial connector plug according to claim **3**, further comprising:

an outer terminal connected to the first center conductor and extending linearly along a direction orthogonal to the axial direction.

8. The coaxial connector plug according to claim **4**,

wherein the first outer conductor is configured to insert a second outer conductor in a substantially tubular shape of a coaxial connector receptacle, and

the first center conductor is configured to insert a second center conductor of the coaxial connector receptacle.

9. The coaxial connector plug according to claim **2**,

wherein the first outer conductor is configured to insert a second outer conductor in a substantially tubular shape of a coaxial connector receptacle, and

the first center conductor is configured to insert a second center conductor of the coaxial connector receptacle.

10. The coaxial connector plug according to claim **5**,

wherein the first outer conductor is configured to insert a second outer conductor in a substantially tubular shape of a coaxial connector receptacle, and

the first center conductor is configured to insert a second center conductor of the coaxial connector receptacle.

11. The coaxial connector plug according to claim **3**,

wherein the first outer conductor is configured to insert a second outer conductor in a substantially tubular shape of a coaxial connector receptacle, and

the first center conductor is configured to insert a second center conductor of the coaxial connector receptacle.

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